

# Claims

[c1] What is claimed is:

1.A while drilling system of a downhole drilling tool suspended from a drilling rig via a drill string, the downhole drilling tool positioned in a wellbore penetrating a subterranean formation, comprising:

at least one drill collar having a tubular sidewall defining a passage therein for the flow of drilling mud therethrough, the drill collar operatively connectable to the downhole drilling tool;

a while drilling tool supported in the passage of the at least one drill collar and selectively retrievable therefrom; and

at least one external sensor positioned in the sidewall of the drill collar and isolated from the passage, the at least one sensor exposed to the wellbore for measurement thereof, the sensor adapted to wirelessly communicate with the while drilling tool.

[c2] 2.The system of claim 1 wherein the at least one external sensor measures one of gamma ray, shock, vibration, pressure, temperature, sonic speed, arrival time and combinations thereof.

- [c3] 3.The system of claim 1 further comprising at least one while drilling sensor positioned inside the downhole drilling tool and adapted to measure one of gamma ray, shock, vibration, pressure, temperature and combinations thereof.
- [c4] 4.The system of claim 3 wherein the at least one external sensor is adapted to measure annular pressure.
- [c5] 5.The system of claim 1 further comprising at least one while drilling sensor positioned in the while drilling tool, the at least one sensor adapted to measure one of an internal pressure in the drill collar, an external pressure outside the drill collar and combinations thereof.
- [c6] 6.The system of claim 5 wherein the at least one while drilling sensor is exposed to the passage for measurement of parameters thereof.
- [c7] 7.The system of claim 5 wherein the at least one sensor is isolated from the passage and exposed to the wellbore for measurements of parameters thereof.
- [c8] 8.The system of claim 1 further comprising a while drilling signal assembly in the while drilling tool and a sensor signal assembly in the sensor for wirelessly passing signals therebetween.

- [c9] 9.The system of claim 8 wherein the signal and sensor assemblies are provided with one of legacy ceramics, silicon on insulator, multichip modules, field programmable gate array, and combinations thereof.
- [c10] 10.The system of claim 9 wherein the signals are communication signals.
- [c11] 11.The system of claim 10 wherein the communication signals are one of commands sent to the sensor, data sent to the while drilling tool and combinations thereof.
- [c12] 12.The system of claim 9 wherein the signals are power signals for providing energy to the sensor.
- [c13] 13.The system of claim 1 further comprising a control system adapted to communicate with the at least one external sensor.
- [c14] 14.The system of claim 13 wherein the control system comprises one of a controller, a processor, a data acquisition module, a transmitter, a receiver, a communication circuit and combinations thereof.
- [c15] 15.The system of claim 13 wherein the at least one external sensor comprises one of a transmitter, a receiver, a gauge, a power source and combinations thereof.

- [c16] 16.The system of claim 15 wherein the power source is chargeable by the while drilling tool.
- [c17] 17.The system of claim 1 further comprising a locking mechanism adapted to orient the while drilling tool in the drill collar.
- [c18] 18.The system of claim 17 wherein the locking mechanism comprises a key positioned in the drill collar and a keyway positioned on the while drilling tool for receiving the key.
- [c19] 19.The system of claim 1 wherein the while drilling tool comprises and continuous direction and inclination tool.
- [c20] 20.The system of claim 1 wherein the while drilling tool is adapted to take continuous measurements in real time.
- [c21] 21.The system of claim 1 wherein the while drilling tool is adapted to perform in high temperature and pressure conditions.
- [c22] 22.A method of measuring downhole parameters while drilling, comprising:  
advancing a downhole drilling tool into the earth to form a wellbore, the downhole drilling tool comprising an at least one drill collar with a while drilling tool therein, the

at least one drill collar having a tubular sidewall defining a passage therein for the flow of drilling mud therethrough;

sensing wellbore parameters via at least one external sensor positioned in a pocket of the tubular sidewall, the at least one external sensor isolated from the passage; wirelessly passing signals between the while drilling tool and the at least one external sensor; and selectively retrieving the while drilling tool from the downhole drilling tool.

[c23] 23.The method of claim 22 further comprising sensing one of wellbore parameters, internal parameters and combinations thereof via the at least one while drilling sensor positioned in the while drilling tool.

[c24] 24.The method of claim 22 wherein the signals are one of communication signals, command signals, power signals and combinations thereof.

[c25] 25.The method of claim 24 wherein the communication signals comprise data retrieved from the at least one sensor and passed to the while drilling tool.

[c26] 26.The method of claim 24 wherein the signals are power signals for providing energy to the sensor.

[c27] 27.The method of claim 22 further comprising transmit-

ting signals from the while drilling tool to the surface.

[c28] 28.The method of claim 22 further comprising recording data received from the at least one sensor.

[c29] 29.The method of claim 22 further comprising transmitting signals from the while drilling tool to at least one component in the downhole drilling tool.

[c30] 30.The method of claim 22 further comprising processing data received from the at least one sensor.

[c31] 31.A sensor system for determining downhole parameters, the system positioned in a downhole drilling tool suspended in a wellbore below a drilling rig, the system comprising:  
a retrievable while drilling tool positioned in the downhole drilling tool, the while drilling tool having an internal passage therethrough for the passage of mud,  
at least one sensor positioned in a drill collar of the downhole drilling tool and isolated from the passage, the at least one sensor adapted to measure wellbore parameters, the pressure sensor adapted to wirelessly communicate with the while drilling tool whereby signals are passed therebetween.

[c32] 32.The system of claim 31 wherein the signals are one of power signals, communication signals, command signals

and combinations thereof.

[c33] 33.The system of claim 32 wherein the at least one sensor and while drilling tool each comprise one of a transmitter, a receiver and combinations thereof for wireless communication therebetween.

[c34] 34.The system of claim 31 wherein the while drilling tool comprises a telemetry system for communicating with a surface unit.

[c35] 35.The system of claim 31 wherein the at least one sensor measures one of gamma ray, shock, vibration, pressure, temperature, sonic speed, arrival time and combinations thereof.

[c36] 36.The system of claim 31 further comprising at least one while drilling sensor positioned on the while drilling tool.